United States Military Academy
West Point, New York 10996

BRAC 2005 Implementation Decision Support Tools

OPERATIONS RESEARCH CENTER OF EXCELLENCE
TECHNICAL REPORT No. DSE-TR-0409
DTIC #: ADA426284

Lead Analyst
Major John Harris, M.S.
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Analysts
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Cadet Randy Mounts

Approved by
Colonel William K. Klimack, Ph.D.
Associate Professor and Acting Head, Department of Systems Engineering

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The Operations Research Center of Excellence is supported by the Assistant secretary of the Army (Financial Management & Comptroller)

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Abstract

This project was a West Point Department of Systems Engineering cadet research project sponsored by the Deputy Assistant Secretary of the Army for Installation Analysis who, in coordination with the Assistant Chief of Staff for Installation Management's Base Realignment and Closure (BRAC) Division, requested three related but distinct project tasks. The first task was a historical analysis of the Army's BRAC implementation performance. The second task was to develop a "BRAC Installation Complexity Matrix" which would be used by BRAC 2005 implementation planners to assess the difficulty at each installation of realigning missions, closing the base, and disposing of excess property. The third task was to develop BRAC 2005 implementation performance measures. To perform these tasks, we reviewed reports on past BRAC rounds, interviewed key stakeholders, and collected data on past BRAC rounds. Based on our research, we identified possible hypotheses about factors that influence installation complexity. We then analyzed the data using descriptive statistics and regression analysis to determine the validity of the hypotheses. We used our research to develop a BRAC 2005 Installation Complexity Model. The model was implemented as a decision support tool using Logical Decisions software and Excel. Based on our research and historical data analysis, we also developed performance measures to assess BRAC 2005 implementation progress.

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Major John K. Harris received his M.S. in Systems Engineering from the University of Virginia. He holds a B.S. from the United States Military Academy in Operations Research. He is currently an Assistant Professor at the United States Military Academy at West Point. He teaches system simulation, computer aided systems engineering, and engineering economics.

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There were several individuals who significantly contributed to the success of this research project. Our project sponsor, Dr. Craig College, Deputy Assistant Secretary of the Army (Infrastructure Analysis), funded the project and provided valuable insight and guidance. Additionally, COL Douglas Baker, Director of the Army BRAC Office and COL Bill Tarantino from the Total Army Basing Study (TABS) Group ensured we had access to key stakeholders and the resources necessary to complete the project. Mr. Rob Dow (from the TABs office), Mr. Bill O'Donnell (from the BRAC Office), and Mr. Joe Matore (from the TABS office) were instrumental in providing background on BRAC implementation issues, identifying key experts, providing BRAC historical data, and arranging our interviews and panel discussions. In addition, they provided timely, valuable feedback on project deliverables and wise counsel on project management.

Disclaimer

Executive Summary

Introduction

This project was a West Point Department of Systems Engineering cadet research project sponsored by the Deputy Assistant Secretary of the Army (Infrastructure Analysis) and supported by the Assistant Chief of Staff for Installation Management's Base Realignment and Closure (BRAC) Division. The Army has the identified two BRAC 2005 implementation goals: 1) close or realign 60% of BRAC 2005 installations within three years and 2) achieve disposition of 60% of BRAC excess property within six years. The purpose of the project was to provide management tools to help the Army meet these goals.

Project Tasks

The project involved three related tasks. The first task was the analysis of Army historical BRAC implementation performance. The second task was to develop a "BRAC Installation Complexity Matrix" which would help BRAC 2005 managers assess each installation's challenges to realign missions, close the base, and dispose of excess property. The third task was to recommend BRAC 2005 implementation performance measures.

Methodology

To complete these tasks, we collected data on past BRAC rounds through research, stakeholder interviews, and meetings. We identified possible hypotheses and analyzed the hypotheses using statistical analysis. With our research data, we used affinity diagramming to group the complexity factors and organize the performance measures. We developed the BRAC Installation Complexity Model using multiple objective decision analysis. The final model was implemented using Excel software. The performance measures were organized using four categories: responsibility, planning, implementation, and completion.

Data Analysis

The data analysis phase provided an assessment of the Army's historical BRAC record and allowed us to analyze the effects of individual factors on BRAC implementation performance. In past BRAC rounds, the Army did not meet the BRAC 2005 strategic goals for installation closure and property disposition. Small data sets, non-continuous data, and qualitative factors limited our ability to statistically identify the complexity drivers. However, we used our data analysis insights to develop the complexity model.

BRAC 2005 Installation Complexity Model

RAND[1] originated the idea of a BRAC installation complexity matrix. Using characteristics that assess the challenges of realigning units, closing installations, and disposing of excess property; the matrix would assess the relative difficulty for each installation and provide an overall assessment of the BRAC 2005 implementation challenges. Using our affinity diagramming process, we identified 38 measures and aggregated these to 10 measures. Using these measures, our model used multiple objective decision analysis to evaluate installation complexity on a scale of 0 to 10. We tested our model using three BRAC installations that have been closed.

BRAC 2005 Performance Measures

We used our research, an engineering management approach, and affinity diagramming to develop BRAC 2005 performance measures that can be used to manage implementation. We grouped the performance measures into four categories: responsibility, planning, implementation, and completion.

Conclusion

If accepted by key stakeholders, the complexity matrix and performance measures can provide useful management tools to help meet Army senior leaders meet their BRAC 2005 implementation goals. The BRAC 2005 Implementation Complexity Model can be a useful tool for BRAC implementation planning and resource allocation decisions. In addition, the performance measures can help Army leaders achieve BRAC implementation success.

Areas for Further Research

We identified three major areas for future work:

- **BRAC Historical Data Analysis.** Although there was not sufficient data for standard statistical analysis, there may be other approaches that might we useful; for example Bayesian Networks and Neural Networks. The success of these methods may depend on the ability to capture important non-quantitative data including political, organization, and personnel factors.
- **BRAC 2005 Implementation Complexity Model.** The aggregated BRAC Installation Complexity Model should be vetted with key Army stakeholders. The complexity functions and weights need to be

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[1] Lachman, Beth, Ellen M. Pint, and David Oaks, *Lessons Learned from the Implementation of Previous BRAC Decisions*, RAND, Arroyo Center, AB-745-A, August 2003.

refined. The model should be tested and validated using BRAC 1995 data. Once completed, the model will be ready for use in summer 2005.

- **BRAC 2005 Implementation Performance Measures.** The performance measures should also be reviewed with key Army stakeholders. In addition, the performance measures should be implemented with four perspectives: installation, Installation Management Agency region, Major Command, and Army. A web-based system would be ideal to allow managers to view BRAC implementation progress at any of the four perspectives.

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Chapter 1 Introduction

1.1 Background

Major Base Realignment and Closure (BRAC) studies are requested by the Secretary of Defense and legislated by Congress. BRAC Commissions are appointed by the President to review DoD recommendations and make their own recommendations to Congress and the President. Prior BRAC rounds were in 1988, 1991, 1993, and 1995. At the request of the Secretary of Defense, Congress enacted legislation in 2002 for a BRAC round to be completed in 2005. According to current plans, the BRAC Commission will be appointed in the spring of 2005 and the new BRAC list will be signed into law by the President in May 2005.

The primary reason to realign units and close installations is the potential economic savings. "Closure" of an installation means that all the active Army missions at an installation have been transferred (realigned) or deactivated. "Disposal" or "disposition" refers to transferring the ownership of an installation's facilities and land to a public or a private organization. The realignment of units from an installation and disposition of an Army installation is a difficult task, especially if many units are involved and significant environmental cleanup is required. If the units are realigned to another installation, the Army must ensure the units maintain maximum combat readiness while caring for the well being of its soldiers and their families. Compounding the challenge is the impact of installation closure on civilian employees and local communities. Also, the property will be transferred to federal organizations, state organizations, non-profit organization, or civilian developers. These organizations have different concerns and timelines. The quicker the Army completes the tasks associated with closing an installation and disposing of the property, the sooner the Army receives the projected economic benefits.

In prior BRAC rounds, the Army's BRAC Office (BRACO) tasked with the mission of closing and disposing of Army installations initially used the time to close an installation as the main performance measure. BRACO later used acreage as a more meaningful performance measure. For instance, if an installation has a total of 100,000 acres and all but one acre is disposed, then the installation has not completed disposition. However, more than 99% of the total acres of that installation are disposed and most of the economic savings have been realized. Thus acreage has become the primary performance measure.

BRAC 2005 involves new challenges and a greater expectation for improved implementation performance. The *BRAC 2005 Strategic Plan* developed by The Army Basing Study (TABS) office for Dr. Craig College, Deputy

Assistant Secretary of the Army (Infrastructure Analyses), set a goal to 1) close or realign 60% of BRAC 2005 installations within three years or less and 2) achieve disposition of 60% of BRAC excess property within six years or less.

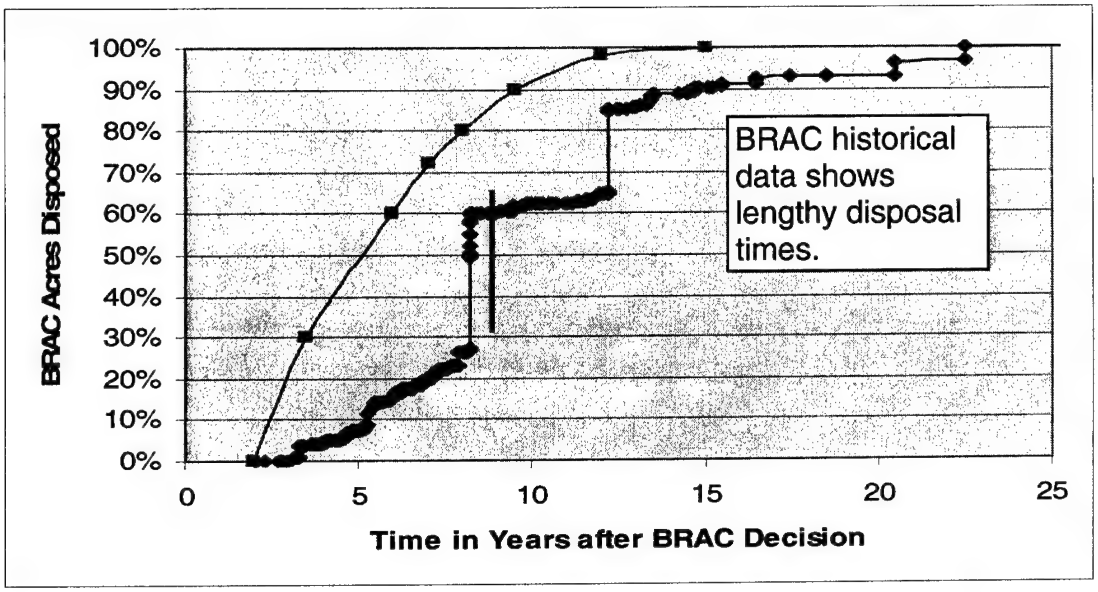

Figure 1.1 BRAC acres disposed (Actual vs. Hypothetical Expected Performance)

Figure 1.1 shows the challenges that the Army faces in the next round of BRAC. The line on the right shows the cumulative history of all the previous BRAC rounds. On average, it has taken the Army over 8.2 years to dispose of 60% of the total acreage from the prior BRAC rounds. Approximately 10% of the total acres have not been disposed. The line on the left shows a hypothetical expected performance that would support the Army's acreage disposal objectives for BRAC 2005. To meet the Army's goals, Army leaders must understand the unique challenges of each installation and develop a management plan to achieve BRAC implementation success.

1.2 Tool to Assess BRAC Installation Complexity

The idea of an installation complexity matrix originated from Beth Lachman, Ellen M. Pint, and David Oaks in their Rand Report on Lessons Learned from the Implementation of Previous BRAC Decisions (Lachman et al., 2003). The BRAC installation complexity matrix would help decision makers assess the degree of difficulty in realigning units, closing bases, and disposing of installations. Table 1.1 shows an example of RAND's matrix. The left hand side of the matrix list installation characteristics that would make BRAC implementation more difficult.

To illustrate the concept, Rand assessed two installations from pervious BRAC rounds. Cameron Station was an example of an installation that was relative easy to close and transfer to commercial developers. Fort Ord is an example of an installation that has been extremely challenging. This evaluation could be made by a qualitative method (colors), quantitative method (numerical scales) or combined method (quantitative scales summarized into qualitative categories).

Key characteristics of the installation	Cameron Station	Fort Ord
Number of jurisdictions that base touches?	Low	[redacted]
Economic dependence of the community on the installation?	Low	Medium
Military and retiree populations?	[redacted]	Low
Diverse stakeholders with interest in the property?	Low	[redacted]
Amount of UXO on the property?	Low (None)	[redacted]
Environmental issues?	Low	[redacted]
Number of acres?	Low	[redacted]

Table 1.1 RAND Complexity Matrix Example

1.3 Need for Better BRAC Implementation Performance Measures

Many Army leaders realized that acreage transferred was a lagging indicator of BRAC implementation success. They believed that BRAC 2005 implementation leaders must identify performance measures that would help Army leader's better focus on the key milestones that would enable timely realignment of units and disposal of Army facilities and installations.

1.4 Study Tasks

This project was a West Point Department of Systems Engineering cadet research project sponsored by the Deputy Assistant Secretary of the Army (Infrastructure Analysis) and supported by the Assistant Chief of Staff for Installation Management's Base Realignment and Closure (BRAC) Division. Our study sponsors requested that we accomplish three interrelated tasks.

- **Analyze the BRAC Closure Performance Record.** This first task involved analyzing the historical data on realignment, closure, and disposition. The purpose of the analysis was to provide insights to support the following two tasks.

* **Develop an Installation Complexity Matrix.** This task involved identifying the characteristics that determine an installation's closure and disposition difficulty and then develop an installation complexity model to help assess how difficult each installation will be to close and dispose.

* **Recommend BRAC 2005 Implementation Performance Measures.** The final task involved reviewing historical BRAC performance measures and the current TABS strategic plan and then developing measures for BRAC implementation progress.

1.5 Study Methodology

In order to accomplish the three tasks, we used the methodology shown in Figure 1.2. In Step 1, we collected data and conducted research on past BRAC rounds. We also interviewed several key Army leaders and had panel meetings with personnel involved in previous BRAC rounds. Step 2 was the data analysis to assess past BRAC implementation performance. To the extent possible, we used statistical analysis techniques. In Step 3, we used affinity diagramming to identify strategic objectives and to organize the data for the installation complexity model and the BRAC implementation performance measures. Step 4 was the refinement of the new BRAC 2005 implementation strategic objectives based on our affinity diagramming. Step 5 was the development of installation complexity models. After research and interviews were conducted and the drivers of prior BRAC rounds were assessed, then the installation complexity model could be developed to provide a management tool that would help decision makers assess the degree of difficulty in mission realignment, installation closure, and property disposal. Finally, Step 6 was the identification of BRAC 2005 Implementation Performance Measures. An engineering management approach was taken to develop the measures. Performance measures were developed in four areas: 1) Responsibility, 2) Planning, 3) Implementation, and 4) Completion.

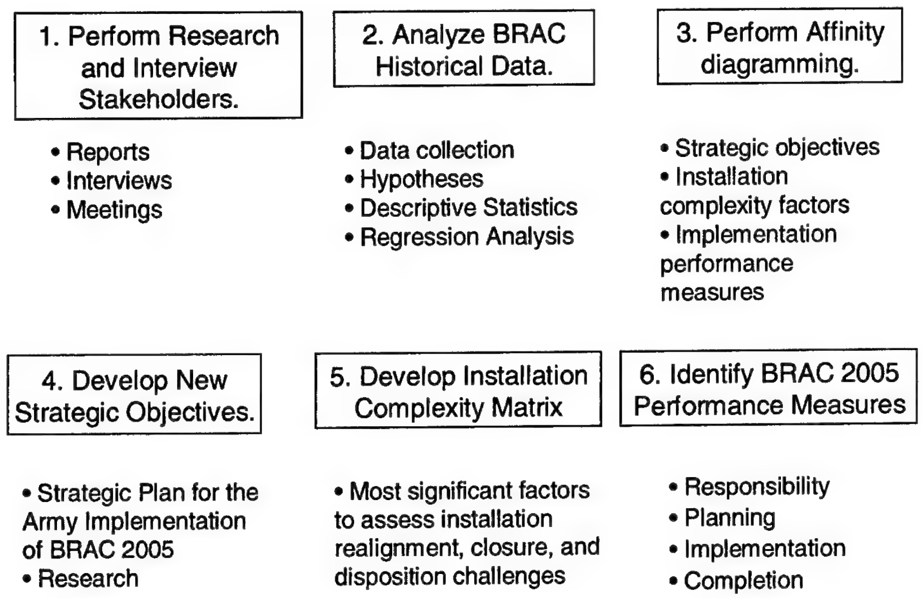

Figure 1.2 BRAC 2005 Implementation Project Methodology

1.6 Overview

Chapter 2 provides the research and interview findings. Chapter 3 provides the analysis of BRAC historical data. Chapter 4 describes the affinity diagramming process we used to organize our research data and interview findings. Chapter 5 describes the revised BRAC 2005 strategic objectives. Chapter 6 describes the development of the BRAC 2005 Installation Complexity Model. Chapter 7 describes the development of the BRAC 2005 Implementation Performance Measures. Finally, Chapter 8 summarizes our conclusions and identifies areas for future research.

Chapter 2 Research and Interview Findings

We began our project by conducting research on the BRAC lessons learned and interviewing key stakeholders and subject matter experts.

2.1 Research

Our research included previous BRAC implementation reports by the Army and studies by RAND and the General Accounting Office. The documents we reviewed are included in the bibliography. One of the key reports we reviewed, was the RAND report that suggested the Installation Complexity Matrix concept (Lachman et al., 2003).

2.2 Stakeholder Interviews

We interviewed senior Army leaders, BRAC implementation project managers, and subject matter experts on the BRAC process to include environmental and legal experts. Additionally, we interviewed several analysts who have written BRAC analysis reports. Appendix B provides a list of the stakeholder interviews and meetings.

Dr. Craig College, DASA (IA), identified the two BRAC 2005 implementation goals: 1) close or realign 60% of BRAC 2005 installations within three years or less and 2) achieve disposition of 60% of BRAC excess property within six years or less. Dr. College recognized that the Army needed a management tool to assess installation complexity to help manage resources to meet the two challenging goals.

The Deputy Assistant Chief of Staff for Installation Management (ACSIM) and the Director of the BRAC Office (BRACO) noted that acreage has been the dominant performance measure for assessing BRAC implementation performance. They also stated that in BRAC 2005 the law has changed so the Army would be able to sell the property to local developers instead of executing no cost conveyance which is essentially giving the land away. However, the Army remains responsible for the bills for environmental clean-up. Additionally, the Deputy ACSIM pointed out that the number of communities involved in the Local Reuse Authorities (LRA) was an indicator of the

difficulty in transferring the bases' assets and land. A LRA is local organization consisting of local businesses and citizens who are responsible for planning a base's reuse (ICMA, 2002). Fort Ord is an example of an installation with a long disposition time and the LRA participants had very differing views on how the community should use the land. The ensuing debate added to the time to dispose of the installation. Finally, the some senior leaders noted that to realign a mission and dispose of an installation costs money, but the Army has not always provided sufficient funding to expedite installation cleanup and disposal.

Mr. Patrick O'Brien, Director, Office of the Secretary of Defense (OSD) Office of Economic Adjustment emphasized that all branches of service need to do a better job of involving the communities surrounding an installation selected for realignment and closure.

An interview with Beth Lachman and David Oaks, analysts from the RAND Corporation, proved to be very beneficial. They suggested looking at the number of congressional districts, the percentage of employment that an installation provides, and consider the resale values of the installation as well as the resale value of key assets on the installation are all critical factors. They additionally pointed out that installations that already have privatized utilities may be easier to resell since it already meets state utility requirements. They also suggested the use of a complexity matrix to use as a decision tool to show the challenges in realigning and closing an installation.

Since BRAC implementation requires many unique skills and knowledge, BRAC project managers identified a need for project managers training, a "BRAC 101." Additionally, they stated that one of the key success factors was a stable transition team. They also suggested one common document to identify the environmental characterization of an installation. They believed that the BRAC project managers should assist the formation of a LRA and development of their reuse plan. It is important to note that the BRAC Office does not control how quickly a LRA is established or how quickly it develops its reuse plan; but, these two steps are on the critical path in the disposition process.

The BRAC Office environmental panel supported the environmental characterization issues brought up by the project managers. They emphasized the difficulties of disposing an installation with Munitions of Explosive Concern (MEC), formerly referred to as Unexploded Ordnance (UXO), as well as ground water plumes, per chlorate, arsenic and other contaminants.

Several of the people we interviewed, the project mangers panel, and the environmental subject matter experts panel all emphasized that 1) an early environmental baseline characterization was essential to develop the clean up

plan, 2) early funds need to be programmed and budgeted, and 3) an early start to Military Construction were critical to the success in implementing realignment, closure, and disposition.

From our interviews, we learned that many stakeholders and subject matter experts had strong beliefs about the major factors that increase acreage disposition times. For instance, many people stated four installation factors tend to increase disposal time: 1) larger size (more acres), 2) larger facilities (square footage), 3) presence of MEC, and 4) low property values. Our next task was to determine if the data from the four previous BRAC rounds supported these beliefs.

Chapter 3 BRAC Historical Data Analysis

In this chapter, we discuss Step 2 of our methodology, the analysis of the data we obtained by data collection, research, and stakeholder interviews. Our objective in this chapter was twofold. First, we assessed past BRAC implementation performance relative to the BRAC 2005 goals. Second, we attempted to determine what drivers most influenced the historical performance of BRAC implementation. Our raw data was mostly provided by the Army's BRAC office and the primary analysis tool was statistical analysis using Microsoft Excel. In the end, we were able to gain an accurate assessment of past performance, but were not able to statistically identify specific factors that significantly drove the implementation process.

3.1 Historical Installation Closure and Disposition Times

We used two key objectives from the BRAC 2005 Strategic Plan (discussed in our interview with Dr. College) as our measures for evaluating past rounds. These objectives are to close 60% of the identified installations within 3 years and to dispose of 60% of BRAC excess property within 6 years of BRAC initiation. In Table 3.1 below, we see that these objectives have never been met in past BRAC rounds. The shortest time to dispose an installation was just over 3 years, while the average time to dispose an installation is 8.2 years. Furthermore, there are installations from the 1988 BRAC list that are still not closed resulting in a disposition time of over 15 years and counting. The BRAC 2005 implementation team faces a difficult challenge. They must find ways to significantly improve past performance.

BRAC Round	# of Installations	# Closed 3 yrs	% of Total Inst. In Round	Median Closure Time	# Disposed 6 yrs.	% of Total Inst. In Round
1988	28	0	0%	5.59	12	43%
1991	6	0	0%	3.80	3	50%
1993	4	1	25%	4.10	2	50%
1995	33	11	33%	3.45	17	52%
Cumulative	71	12	17%	4.38	34	48%

Table 3.1 Number and Percent of Installations Closed and Disposed in each BRAC round

3.2 Historical Acreage Disposal Time

As we noted in Section 1.1, past measures of disposition progress have been primarily based upon the number of excess acres disposed.

Table 3.2 shows a summary by round of the time to achieve 60% and 80% disposal of the excess acreage. Again, the goal is to achieve 60% disposition within 6 years. As the third column indicates, this has only happened once, and that was for a round that had very few acres. The last column shows that the Pareto effect applies to acreage disposition. For each round, nearly, if not more than, half of the acreage in each round may be disposed by disposing of one or two installations. Therefore, as a general rule, the BRAC 2005 implementation team should focus on disposing of the largest parcels of land first. However, it is important to remember that the real focus should always be on the dollar savings potential.

BRAC Round	Total BRAC Acreage	Years to 60% Disposal	Years to 80% Disposal	Drivers
1988	87,997	12	12	Jefferson Proving Ground (50,385)
1991	34,535	15	23	Two Ft. Ord parcels (14,773)
1993	2,664	6	6	Tooele Army Depot (1,621)
1995	133,750	8	8	Sierra Army Depot (57,633)

Table 3.2 Total Time to Dispose Of 60% And 80% of the Total Acres in Each Round

Figure 3.1 shows the historical (and projected) disposition data per BRAC round in excess acres while Figure 3.2 shows the disposition data in percentage of excess acres for each of the rounds over time. The data is normalized to time zero based on the date the BRAC round was signed into law. The arrows show the current year. Any data points beyond the arrows shown for each round represent planned disposals. Therefore, that data is still subject to change. The BRAC 1995 story would be much different without the significant acreage disposal in year 8 (2003). It is interesting to note that senior DoD and Army leadership focus on acreage transfer "inspired" the significant progress in 2003.

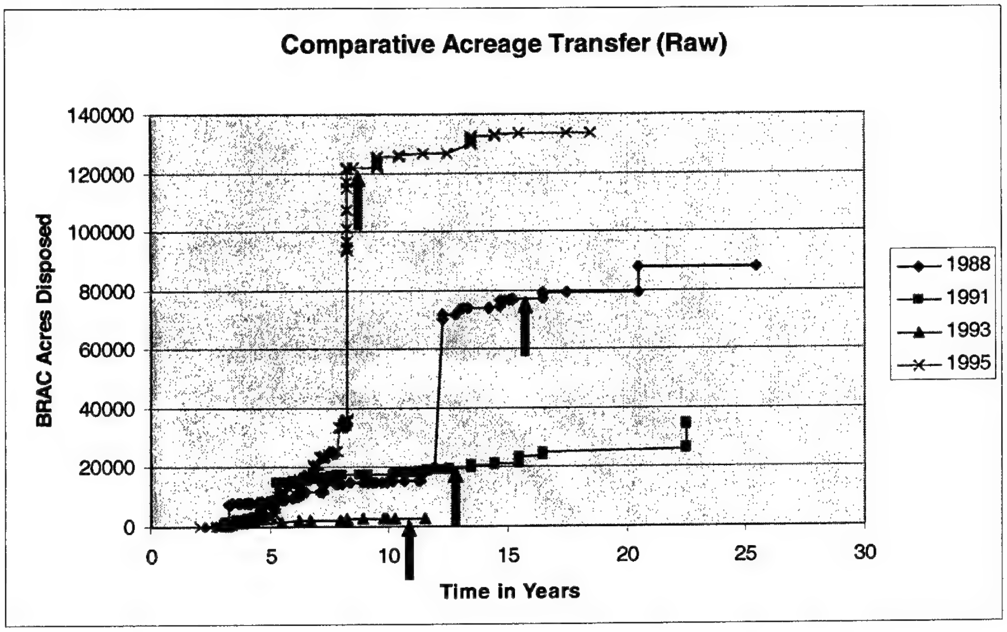

Figure 3.1 Comparative Raw Acreage Transfers (Each Round Normalized To Year Zero)

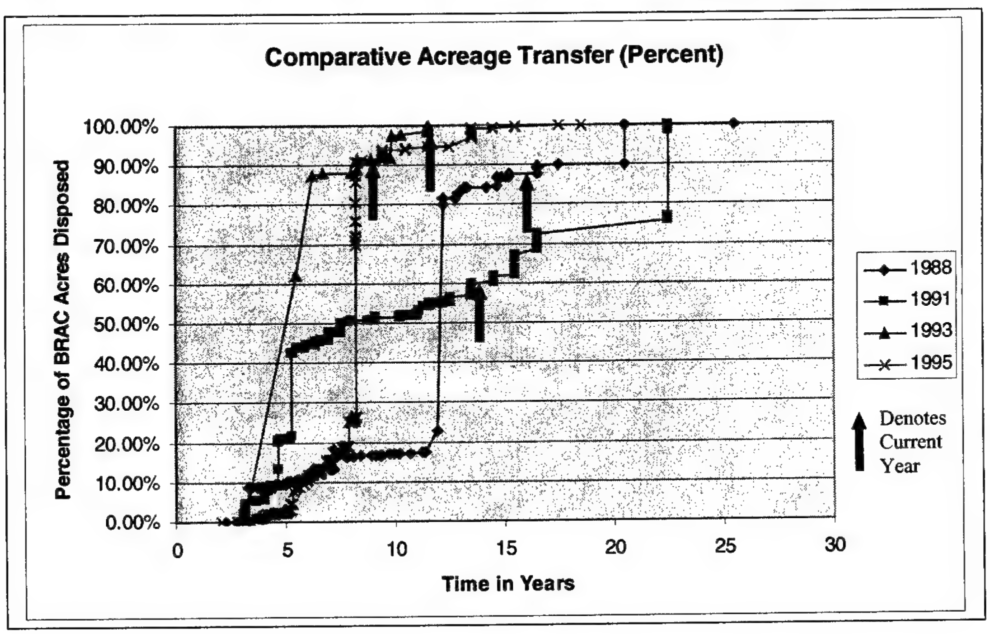

Figure 3.2 Comparative Percent Acreage Transfer (Each Round Normalized To Year Zero)

3.3 Identification of Closure and Disposal Time Drivers

Next, we used linear regression to identify the most important drivers of closure and disposal time. We used Microsoft Excel and Mathematica as our primary software. Our goal was to identify specific factors that significantly correlated to the BRAC implementation performance. Key measures include time to closure, time to disposition, and various cost factors. Our methodology was to first identify those factors that we thought might be significant (hypotheses). Many factors were brought to our attention in the research and interview process. Next, we requested data concerning all of these factors from the BRAC Office. Finally, we used BRAC historical data to try to support hypotheses using linear regression charts and bar charts. We computed an R^2 value for all linear regression plots and analyzed data in the bar charts.

With a couple exceptions, we found it difficult to identify single drivers that significantly affected BRAC implementation performance. R^2 values were consistently very low and qualitative comparisons for various installations also led to very few distinguishing variables. A summary of our hypotheses and the statistical analysis results we obtained are shown in Table 3.2

Hypothesis	Data Analysis	Finding
The amount of environmental cleanup lengthens the disposition time.	Actual Environmental Cost vs. Actual Disposition Time	$R^2 = 0.02$
The amount of environmental cleanup lengthens the disposition time.	Estimated Environmental Cost vs. Actual Disposition Time	$R^2 = 0.01$
As environmental cost increases, disposition cost increases.	Actual Environmental Cost vs. Total Cost to Disposition	$R^2 = 0.14$ (removing one outlier $R^2 = 0.32$)
The amount of MEC (UXO) increases the disposition time.	Actual MEC Acreage vs. Actual Disposition Time	$R^2 = 0.12$
The amount of of MEC (UXO) increases the environmental cost.	Actual MEC Acreage vs. Actual Environmental Cost	$R^2 = 0.87$
Larger installations have longer disposition times.	Actual Acreage vs. Actual Disposition Time	$R^2 = 0.0002$ (completed dispositions)
Installations with more square footage take longer to close.	Starting Square Footage Inventory vs. Actual Closure Time	$R^2 = 0.07$ (wrong hypothesis)
Some EPA Regions have longer disposition times.	EPA Region vs. Actual Disposition Time	No sufficient correlation.
Some MACOMs have longer disposition times.	MACOM Owner vs. Actual Disposition Time	TRADOC Dispositions take less time than others.
The type of installation impacts the closure time.	Installation Type vs. Actual Closure Time	Administrative and industrial installations take longer to close than others.
The type of installation impacts the disposition time.	Installation Type vs. Actual Disposition Time	Family housing locations are quicker to dispose than other installation types.
The type of installation impacts the actual cost to disposition.	Installation Type vs. Actual Cost to Disposition	Major training areas cost more for disposal.
Superfund sites have higher environmental costs associated with them	Superfund Site vs. Actual Environmental Cost	Superfund sites incur more environmental costs.

Table 3.3 Prior BRAC Rounds Data Analysis Hypotheses and Findings

We were not able to identify single factors that drove closure time, disposition time, or total costs. The only significant correlations were the expected correlation of MEC acres to clean-up cost ($R^2 = 0.87$) and of MEC acreage to disposition time ($R^2 = 0.32$). We also did a multivariable regression analysis with the data, but found this difficult because of holes in the data and small sample sizes. Many qualitative factors could be represented in the multiple regression models such as EPA region, number of congressional districts near the installation, or Major Command (MACOM) owner. For example, we suspect that having spent munitions of explosive concern (MEC) present could easily combine with other factors to extend and complicate costs and disposition time. Of past installations, however, only 12 actually had MEC present. Therefore, it is very difficult to combine that data with another factor like the EPA region because then we only have 12 data points to spread across 10 EPA regions. Other political, organizational (e.g., availability of funds for BRAC implementation actions), and personnel factors are difficult to categorize and may ultimately drive the BRAC implementation process. Therefore, we were not overly surprised to see only weak correlations based on statistical analysis.

Our research and interviews showed that the BRAC implementation is very complicated. There are qualitative factors such as personnel assignments, organizational structure, political, and local community impacts that may have had an impact on BRAC performance. We also found that each installation is very unique and any historical BRAC analysis should involve someone who is familiar with the history of each individual installation.

Based on our statistical data analysis conclusions, the idea of an installation complexity model that uses both qualitative and quantitative factors from our research, interviews, and data analysis to assess an installations level of difficulty to implement the BRAC decisions seems to be an appropriate management tool.

Chapter 4: Affinity Diagramming

In this chapter, we discuss Step 3 of our methodology. We used affinity diagrams to identify the strategic objectives, group the complexity factors, and develop BRAC implementation performance measures.

4.1 Introduction to Affinity Diagramming

An affinity diagram is a technique that collects large amounts of language data (ideas, opinions, issues) and organizes them into groupings based on their natural relationships. The affinity process is an excellent technique for a team of people to work creatively to identify new relationships[2]. It may be used in situations that are unknown or unexplored, or in circumstances that seem confusing or disorganized, such as when people with diverse experiences form a new team, or when members have incomplete knowledge of the area of analysis. In its simplest form, the affinity process can be used to group ideas of a few individuals generated by brainstorming. In a more complex form, the affinity process can be used to group ideas generated by thorough research and interview process that we have used for our project. In our application, we use affinity diagrams to develop the strategic objectives, the complexity factors, and the implementation performance measures.

4.2 Illustrative Example Affinity Diagram

The data we obtained from our research (including the Strategic Plan), interviews, and data analysis was first grouped into five strategic objectives.

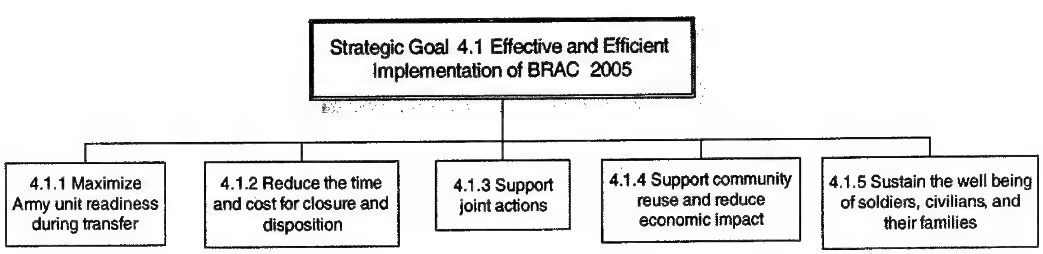

Figure 4.1 Strategic Objectives.

[2] "Affinity Diagrams", Module 4, *The Tools of Total Quality*, http://www.hq.navy.mil/RBA/text/tools.html

Next, we describe the affinity diagrams for the first objective, *4.1.1 Maximize Unit Readiness during Realignment*. (The rest of the affinity diagrams are provided in Appendix C. Affinity Diagramming. Due to size, objective 4.1.2 is divided into 4.1.2 a. with environmental and 4.1.2 b. without environmental). We grouped the data in each objective into two categories: complexity factors and implementation performance measures. The complexity factors (light green) were then binned in to similar groupings. For example, the left hand side of Figure 4.1 shows one of the groupings – mission alignment complexity which has three complexity factors. For the performance measures, we binned the measures into four groups: responsibility, planning, implementation and completion. We selected these bins since they reflect a logical time sequencing of the performance measures. The orange measures are from the BRAC 2005 Strategic Plan. The light blue measures were obtained from our research.

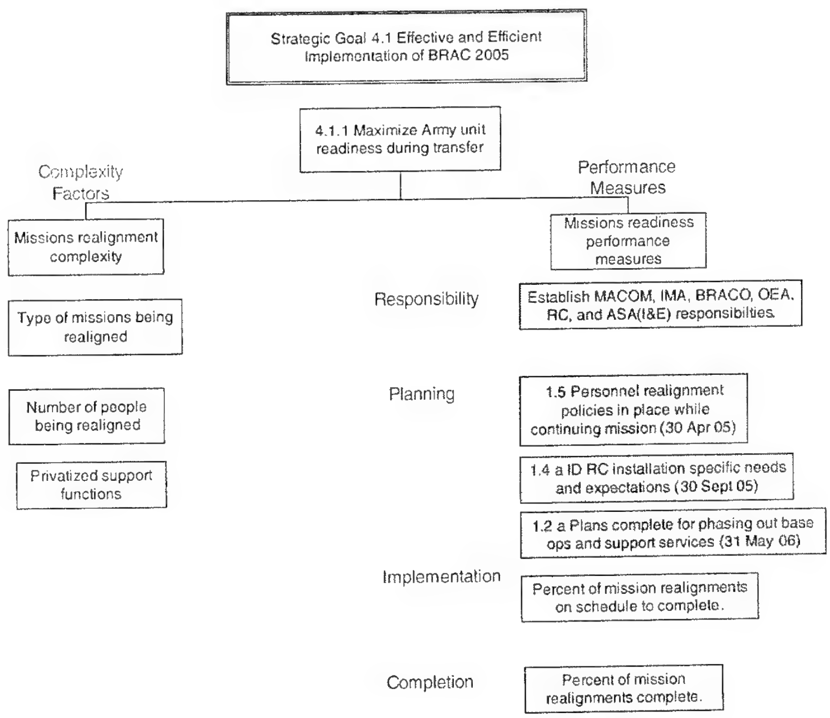

Figure 4.2 Affinity Diagram for Objective 4.1.1.

Chapter 5: Strategic Objectives

In this chapter, we discuss Step 4 of our methodology – developing strategic objectives. We begin by discussing the current BRAC 2005 Strategic Plan and then we describe the strategic objectives we developed using the affinity diagramming process described in the previous chapter.

5.1 Current Strategic Objectives

The objectives in the current strategic plan are shown in the Figure 5.1. The boxes in white are not in the strategic plan. We added them to show the strategic plan as a hierarchy of objectives. As we mentioned in the previous chapter, the boxes in orange were used in the affinity diagramming process.

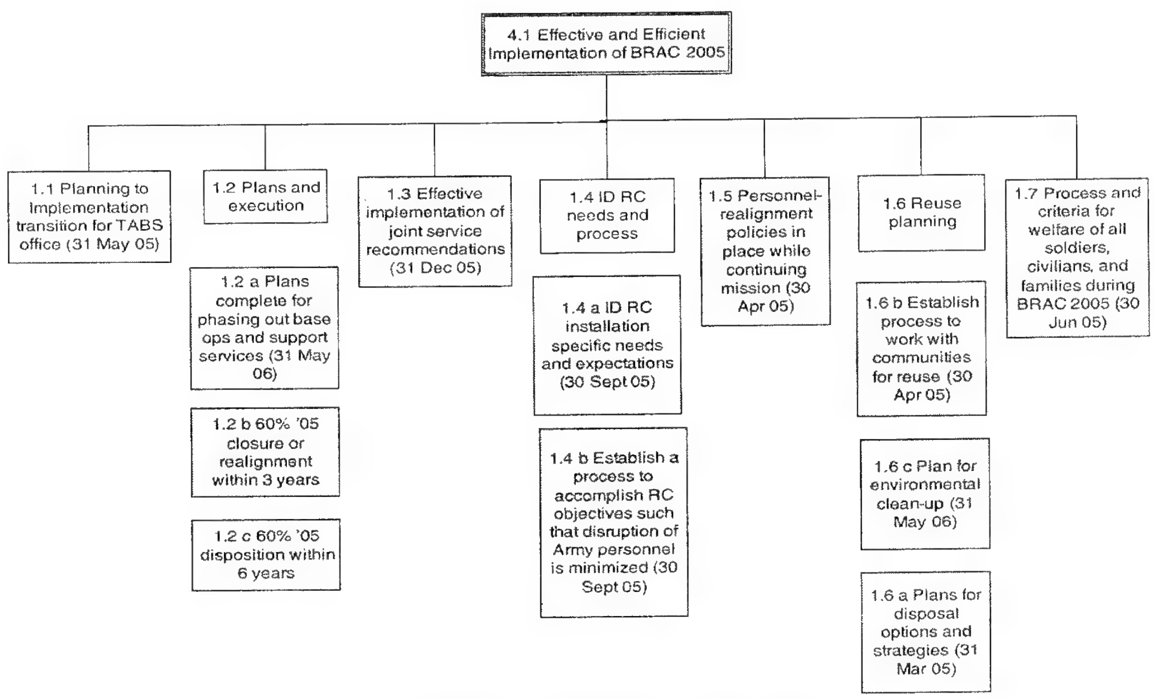

Figure 5.1 Modified Strategic Plan

5.2 New Strategic Objectives

Figure 4.1 displayed the new strategic objectives that we developed using the affinity diagramming process. In this section we describe each of the objectives.

- **4.1.1 Maximize Army Unit Readiness During Transfer.** This strategic objective focuses on maximizing mission readiness during the realignment of an active (or reserve) unit from one post to another. With the current operations tempo of the Army, it is critical that each realigning unit be able to maintain unit readiness and have the ability to perform its mission, if called upon, during the transfer period.
- **4.1.2 Reduce the Time and Cost for Closure and Disposition.** This strategic objective focuses on timely completion of the BRAC actions to enable the Army to obtain the projected savings as soon as possible. However, due to variety of reasons discussed previously, base closure and disposition is a time consuming and costly process. This objective includes the two major cost drivers: environmental cleanup and unexploded ordnance disposal.
- **4.1.3 Support Joint Actions.** This strategic objective is to be able to implement Army BRAC 2005 actions that support joint BRAC actions. This is a new element in BRAC 2005 that has not been a significant factor in previous rounds.
- **4.1.4 Support Community Reuse and Economic Impact.** This strategic objective was emphasized by DoD's OEA. In our interview with Mr. O'Brien[3], he stressed the importance of community impact and stated it was imperative that services help the communities plan for community reuse of excess property to mitigate the impact of the BRAC actions on the local communities.
- **4.1.5 Sustain the Well Being of Soldiers, Civilians and Their Families.** This strategic objective is to maintain, if not enhance, the well being of the soldiers, civilians, and their families who are involved in the BRAC process.

Next, we will discuss how we used the five strategic objectives and the complexity factors from our affinity diagramming exercise to develop the complexity model.

[3] Mr. Patrick O'Brien, Director, DoD Office of Economic Analysis, Interview, 2 March 2004.

Chapter 6: BRAC 2005 Installation Complexity Model

The idea for an installation complexity model was first identified by RAND. The RAND Complexity Matrix was described in section 1.2. This chapter describes our implementation of a BRAC 2005 Installation Complexity Model.

6.1 Need for an Installation Complexity Model

Once DoD forwards the Army recommendations to the BRAC Commission's, the Army will need to assess the challenges to perform the BRAC actions and meet the Army closure and disposition goals. Depending on the number and types of installations impacted by BRAC, this may be a daunting task. The BRAC installation complexity matrix would help BRAC decision-makers assess the degree of difficulty in realigning units, closing bases, and disposing of installations.

6.2 Complexity Model Uses

We have identified the following potential uses of the BRAC 2005 Complexity Model:

- improve senior leaders' understandings of the unique challenges of each installation,
- provide senior leaders an overall assessment of the difficulty of BRAC 2005 implementation,
- help senior leaders assign the most experienced or best-performing personnel to the most challenging installations,
- provide senior leaders a basis for allocating existing resources across installations,
- help explain the need for additional resources on extremely challenging installations, and
- identify the need for training programs for installations that have difficult challenges and inexperienced BRAC implementation personnel.

Until we know the number and types of installations on the BRAC list it is difficult to predict which of these uses will be the most important.

Next, we discuss our installation complexity model development approach.

6.3 Complexity Model Development

In order to develop the BRAC 2005 installation complexity model, we had to decide what measures would be used to evaluate the difficulty of BRAC actions. We developed the measures from our research, interviews, meetings, and data analysis. As described in Chapter 4, we performed affinity diagramming to group the potential measures from our research and interviews to identify the most important complexity measures. Our research effort focused on section 4.1 of the Strategic Plan for the Army Implementation of BRAC 2005: Effective and Efficient Implementation of BRAC 2005. After conducting our research, we developed a new set of strategic objectives (Figure 4.1) that we described in chapter 5. We used each of these five objectives to organize both the complexity measures and the implementation performance measures. This enabled us to group similar complexity measures and similar performance measures. At the conclusion of our affinity diagramming, we had developed thirty eight complexity measures. These ranged from the type of mission being realigned or closed to the quantity of lead-based paint at an installation.

6.4 Initial Complexity Model with Thirty Eight Measures

We used multiple objective decision analysis to develop our complexity model (Kirkwood, 1997). We input all thirty eight measures into Logical Decisions. The thirty eight measures are listed in Appendix C. One of the Logical Decisions views is a measure scoring matrix (which is similar to RAND's complexity matrix but without colors) with installations on one dimension and complexity measures on the other. The matrix is filled in with the measure scores for each installation. Using Logical Decisions we developed a complexity function for each measure and assigned weights to each measure. The complexity functions are value functions that map an installation's score into a complexity number. We scaled each complexity function from 0 (no complexity) to 10 (very complex). Using the additive complexity (value) model (complexity is the sum-product of the weight times the complexity of each measure), we can then provide an overall quantitative evaluation of installation complexity (0 to 10).

Logical Decisions is a very useful tool because an analyst can compare a single measure from various installations, perform sensitivity analyses, and other analyses (e. g., Monte Carlo simulation) that can not be

obtained with a simple matrix. However, Logical Decisions is a more complex decision aid that requires more understanding of multiple objective decision analysis, which is a limiting factor.

6.5 Aggregated Complexity Model with Ten Measures

Many of the thirty eight measures that we developed can be aggregated into fewer measures. In addition, some of the complexity measures are less important than others or have less variation between installations. The weight assigned a complexity measure depends on the importance of the measure and the variation between installations. Therefore, we were able to identify the broadest and most important measures and narrow the thirty eight down to ten. For example, we assumed that the presence of any of the ten contaminants will drive up the estimated environmental clean-up cost, so these ten measures would aggregate to one estimated environmental clean-up cost measure. While an expanded model using all 38 measures may be more thorough, the aggregated model is more understandable and serves our purposes well as a useful tool for BRAC implementation decision-makers.

The ten measures are listed below under the appropriate strategic objective. In addition, we identify the units used for the complexity measures:

4.1.1 Maximize Army Unit Readiness

1. Type of Mission Realigned (constructed scale)

4.1.2 Reduce the Time and Cost for Closure and Disposition

2. Estimated Closure and Disposition Cost ($ millions)
3. Acres to be Disposed (acres)
4. Appraised Land Value ($ millions)
5. Estimated Environmental Clean-up Cost ($ millions)
6. MEC Acres (acres)

4.1.3 Support Joint Actions

7. Type of Joint Mission Coming to an Installation (constructed scale)

4.1.4 Support Community Reuse and Reduce Economic Impact

8. Urban/Rural (population density)
9. Unemployment Rate (percentage)

4.1.5 Support the Well-Being of Soldiers, Civilians, and their Families

10. Number of People Relocated (number of people)

We implemented this model is Logical Decisions and in Excel. We developed complexity functions for each of the ten measures. The models are identical but the Excel model is simpler to understand and use. We will describe the Excel model in this paper.

In order to develop a more understandable and usable model, we converted the aggregated model from Logical Decisions to Microsoft Excel. Like the Logical Decisions model, the Excel model uses multiple objective decision analysis. For each complexity measure, we looked at the maximum and minimum scores possible for any installation, and then developed a function that represented the relative complexity across the range of these scores. For instance, the presence of MEC at an installation will increase the disposition difficulty; however, after that initial MEC is identified, the difficulty will continue to increase but at a much more gradual pace resulting in a diminishing returns function. Figure 6.1 below is an example of the complexity function we used for MEC acres.

Reduce the Time and Cost for Closure and Disposition		
Evaluation Measure	MEC Acres	
Acres	x	Complexity
	0	0
	10000	8
	20000	8.5
	30000	9
	40000	9.5
	50000	10
Evaluation Measure description.		
Evaluation measure sources:		
Type of evaluation measure		

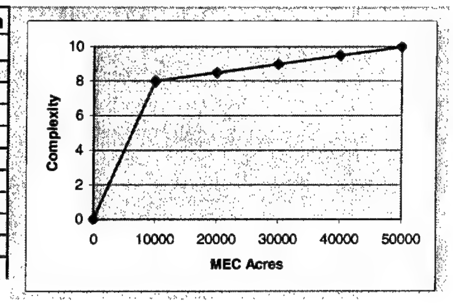

Figure 6.1 Complexity Function for MEC

Whenever possible we developed the complexity function using our data analysis insights. Our interviews, meetings, panels, and research also played a pivotal role in developing these functions. For the complexity function to support the type of mission realigned, depots and labs have a small complexity score based on our data analysis. Some stakeholders and subject matter experts believed that depots and labs were difficult to dispose; however, our data analysis did not support this hypothesis. Thus, the depots and labs in Figure 6.2 had a resulting lower complexity value. All ten complexity functions were developed in a similar fashion as the two shown in Figure 6.1 and 6.2. (See Appendix D for a complete list.)

Maximize Army Unit Readiness		
Evaluation Measure	Type of Mission Realigned	
Mission	x	Complexity
Minor Training AC	1	1.5
Minor Training RC	2	1.5
Housing	3	2.3
Depot	4	2.5
RDT&E / Labs	5	2.7
Major Training AC	6	3
Major Training RC	7	3
Medical	8	3.5
Administration	9	4.3
Industrial	10	4.5
Transport	11	10
Evaluation Measure description.		

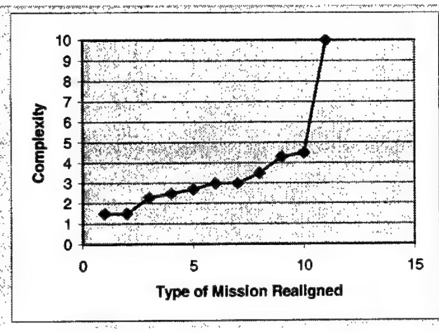

Figure 6.2 Complexity Function for Mission Type

Figure 6.3 displays the full Excel implementation of the Aggregated Complexity Model. The model is divided into several sections:

- The top section of the model provides the qualitative value model and the weights. This includes the five strategic objectives shown in the Function row, the local weights for the functions, the evaluation measures, the local weights for the evaluation measures, and the global weights. The global weights sum to 1.0 and are the product of the local weights above them. The weights used in the model are based on our analysis.
- The next section describes the complexity functions. The complexity value (0 to 10) is shown in the second column and the levels that map to the complexity values are show in the subsequent columns. The constructed scales have qualitative levels.
- Next is the raw data. These are the notional scores for three installations that have been closed in previous BRAC rounds. We used these installations to demonstrate the model. Installation scores are typed into the matrix. The complexity values are calculated using the scores, the complexity functions, and the weights.
- V(x) is the complexity value for the installation score in the section above. The complexity value is obtained using the complexity functions and a macro ValuePL (Kirkwood, 1997). ValuePL looks up exact scores and uses linear interpolation between scores to calculate the complexity value.
- The final section shows the color coding of the complexity values. Red is 7-10 (high complexity), yellow is 4-6 (medium complexity), and green is 0-3 (low complexity). We used the conditional formatting coloring feature in Excel to automatically convert the numbers to colors.

	Function	Maximize Army Unit Readiness	Support Joint Actions	Support the Well-Being of Soldiers, Civilians, and their Families	Reduce the Time and Cost for Closure and Disposition					Support Community Reuse and Reduce Economic Impact	
	Weight (local)	0.03	0.03	0.08	0.7					0.16	
					Closure and Disposition Activities			Environmental Closure			
	Evaluation Measure	Type of Mission Realigned	Type of Joint Mission Coming to an Installation	Number of People Relocated	Estimated Closure and Disposition Cost	Acres to be Disposed	Appraised Land Value	Estimated Environmental Clean-up Cost	MEC Acres	Urban / Rural	Unemployment Rate
	Weight (local)	1	1.00	1.00	0.21	0.20	0.14	0.20	0.24	0.50	0.50
	Weight (global)	0.03	0.03	0.08	0.15	0.14	0.1	0.14	0.17	0.08	0.08
Levels and Complexity (see complexity function for qualitative values)	0	Minor Training AC	None	0	0	0	200	0	0	10000	0
	1	Minor Training RC	Minor Training AC				160				
	2	Housing	Minor Training RC	10000			120			8000	3
	3	Depot	Depot								
	4	RDT&E / Labs	RDT&E / Labs	20000			80			5000	
	5	Major Training AC	Major Training AC								
	6	Major Training RC	Major Training RC	30000	50			40		500	
	7	Medical	Medical		100			80			6
	8	Administration	Administration	40000	150	20000		120	10000	100	9
	9	Industrial	Industrial		200	60000	40	160	30000		12
	10	Transport	Transport	50000	250	100000	0	200	50000	0	15
Raw Data	Red River	Depot	None	2000	27	1000	5	50	500	474.9	8
	Ft. Ord	Major Training AC	None	20000	250	25000	50	100	25000	3828	9.7
	Cameron Station	Administration	None	200	159	500	100	20	2	6370.73	2
x Score	Red River	4	1	2000	27	1000	5	50	500	474.9	8
	Ft. Ord	6	1	20000	250	25000	50	100	25000	3828	9.7
	Cameron Station	9	1	200	159	500	100	20	2	6370.73	2
V(x) Value	Red River	3	0	0	3	0	10	6	0	6	8
	Ft. Ord	3	0	4	10	8	8	8	9	5	8
	Cameron Station	4	0	0	8	0	3	3	0	3	1
Color	Red River										
	Ft. Ord										
	Cameron Station										

Figure 6.3 Complete Aggregated Complexity Model.

Figure 6.4 is the same as the above model except that it is condensed to remove the weights, complexity levels, scores, and complexity value calculations from the users view. Late in our project, we had a suggestion to create two models: one for closure and one for disposition. Instead, we grouped those strategic objectives that support closure and those that support disposition. This explains why they are not in numerical order used in the strategic objectives.

		Closure Measures			Disposition Measures							
	Function	Maximize Army Unit Readiness	Support Joint Actions	Support the Well-Being of Soldiers, Civilians, and their Families	Reduce the Time and Cost for Closure and Disposition					Support Community Reuse and Reduce Economic Impact		
	Evaluation Measure	Type of Mission Realigned	Type of Joint Mission Coming to an Installation	Number of People Relocated	Estimated Closure and Disposition Cost	Acres to be Disposed	Appraised Land Value	Estimated Environmental Clean-up Cost	MEC Acres	Urban / Rural	Unemployment Rate	Total
	Red River											
Color	Ft. Ord											
	Cameron Station											

Green = 0-3

Red = 7-10

Figure 6.4 Summary Model of the Aggregated Complexity Model.

We used our data analysis insights to help develop the weights. For instance, our regression analysis showed that MEC acreage was very likely to drive up environmental costs ($R^2 = .87$), so MEC acreage was weighted more than any other measure because we did not have those kind of results for any other measure. Our data also showed that transport missions were the most difficult to dispose of while a depot or a lab was easier. Since this was contrary to some comments made during our interviews, we weighted the measure "mission to be realigned" lower than most of the other measures. During our research process, many people also emphasized some measures as being more important than others, so this also influenced the weights we assigned.

The Excel tool is simple to use but still uses the mathematical rigor of multiple objective decision analysis to perform the complexity calculations in a manner that is transparent to the user.

Chapter 7: BRAC 2005 Performance Measures

This chapter describes the BRAC implementation performance measures we developed in the 6th step of our methodology.

7.1 Introduction

We used an engineering management approach to performance measures and the affinity diagramming process to identify a full set of implementation performance measures.

7.2 An Engineering Management Approach

We used an engineering management approach to develop a set of leading and lagging metrics that would allow BRAC implementation to be assessed and managed from Presidential decision to completion. We developed a four phase measurement measure approach consisting of the following types of performance measures:

- **Responsibility**: In the first phase, all agencies involved with the BRAC would be made aware of there responsibilities, a chain of command established, and one individual placed in charge of each key process.
- **Planning**: Once the responsible organizations have been identified, all planning should be performed by these organizations. For example, we should establish MILCON needs, funding and timelines. The intent is that all plans would be ready for implementation before the BRAC implementation process begins.
- **Implementing**: This is the management and tracking phase. For example, we would be tracking the acreage transferred, time lines, and percent of budget spent. If we are not on track with our plan, then these metrics would be able to identify the problem in time to develop proper courses of action to put the process back on track.
- **Completion**: These are the lagging metrics that would allow for after action reviews and measure the overall success of the BRAC process.

7.3 Performance Measures

Table 7.1 provides a listing of the major performance measures for each of the five strategic objectives for each performance measure category. The full listing of measures is in Appendix C. The measures in black are already established in the current BRAC 2005 strategic plan and the measures in blue are proposed measures for the revised BRAC 2005 Strategic Plan.

Performance Objective Performance Measures	**Maximize Unit Readiness During Transfer**	**Reduce the time and cost for closure and disposition**	**Support Joint Actions**	**Support Community Reuse and Reduce Economic Impact**	**Sustain the Well Being of Soldiers, Civilians, and their families**
Responsibility	Responsibilities are established within the MACOM, IMA, BRACO, OEA, RC and ASA (I&E) agencies with respect to unit readiness.	Transition from planning phase to implementation phase within the TABS office (31 MAY 2005).	Responsibilities for joint actions established for MACOM, IMA, BRACO, OEA, RC and ASA (I&E).	Community interface established for MACOM, IMA, BRACO, OEA, RC and ASA (I&E).	Personnel responsibilities established for MACOM, IMA, BRACO, OEA, RC and ASA (I&E).
Planning	Personnel realignment policies in place prior to start of BRAC process. (30 APR 05)	Ensure disposal strategies and property disposal plans that maximize BRAC objectives are in place (31 MAR 2005)	Joint action schedules developed by 31 DEC 2005.	Plan in place for community reuse. (30 Apr 05)	Plan in place to accomplish RC objectives such that disruption of Army personnel is minimized. (30 SEPT 05)
Implementation	Number of missions transfers on schedule.	Base transition coordinator is in place and ready to begin (July 2005).	Joint action transfers on schedule to complete.	LRA is organized and in place, ready to begin BRAC process. (31 DEC 2005).	Number of people with assignments or successfully transferred.
Completion	Number of mission transfers complete.	BRAC acres disposed	Number of joint action transfers complete	Number of reuse plans executed.	Number of people reassigned.

Table 7.1: Performance Measure and Strategic Objective Crosswalk.

This section has described the development of the revised strategic objectives and the four phase measurement approach that we recommend be used into a revised BRAC 2005 Strategic Plan. The next step will be to meet with the BRAC stakeholders to coordinate finalize these measures.

Chapter 8: Conclusions

In this final chapter, we summarize our conclusions and identify areas for future research.

8.1 Conclusions

From our research, we learned that the BRAC 2005 implementation team has a daunting challenge to meet the BRAC 2005 objectives to realign units, close installations and dispose of excess property. The historical record shows that the shortest time to dispose of an installation was just over 3 years and the average time to dispose an installation was 8.2 years. There are still installations from the 1988 BRAC list that have not completed disposal.

We learned that the BRAC historical data is not sufficient to statistically predict the time to realign, close, and dispose of an installation. Since not all factors apply to each installation the data sets are small. In addition, many political, organizational and personnel issues may have contributed to the historical BRAC performance.

However, through our research, interviews, panel meetings, and data analysis, we were able to identify key factors that increase the time to dispose of an installation. More importantly, we were able to incorporate these factors into an installation complexity model that can be used as a management decision tool to help identify the most challenging installations for BRAC 2005 implementation.

The installation complexity matrix has several purposes.

1) It can provide senior leaders an overall assessment of the difficulty of BRAC 2005 implementation.
2) It can improve the understanding of the unique challenges of each installation.
3) It can be used as management tool to help assign personnel to the most challenging installations.
4) It can provide a basis for allocating existing resources.
5) It can help explain the need for additional resources.
6) It can identify the need for training programs.

In addition, we used an engineering management approach and affinity diagramming to develop BRAC 2005 performance measures that can be used to manage implementation.

8.2 Areas for Future Work

Finally, we describe three major areas for future work:

- **BRAC Historical Data Analysis.** Although there was not sufficient data for standard statistical analysis, there may be other approaches that might we useful; for example Logistic Regression, Linear Discriminant Analysis, Bayesian Networks[4] and Neural Networks. The success of these methods may depend on the ability to capture important non-quantitative data including political, organization, and personnel factors.
- **BRAC 2005 Implementation Complexity Model.** The aggregated BRAC Installation Complexity Model should be vetted with key Army stakeholders. The complexity functions and weights need to be refined. The model should be tested and validated using BRAC 1995 data. Once completed, the model will be ready for use in summer 2005.
- **BRAC 2005 Implementation Performance Measures.** The performance measures should also be reviewed with key Army stakeholders. In addition, to provide visibility to senior Army leaders, the performance measures should be implemented with four perspectives: installation, Installation Management Agency Region, Major Command, and Army. A web-based system would be ideal to allow managers to view BRAC implementation progress for any of the four perspectives.

A follow-on West Point cadet capstone research project is planned for Academic Year 2004-2005 to focus on the last two areas.

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[4] LTC Pamela Hoyt's Dissertation, George Mason University, focuses on Bayesian Nets and is using our BRAC data set.

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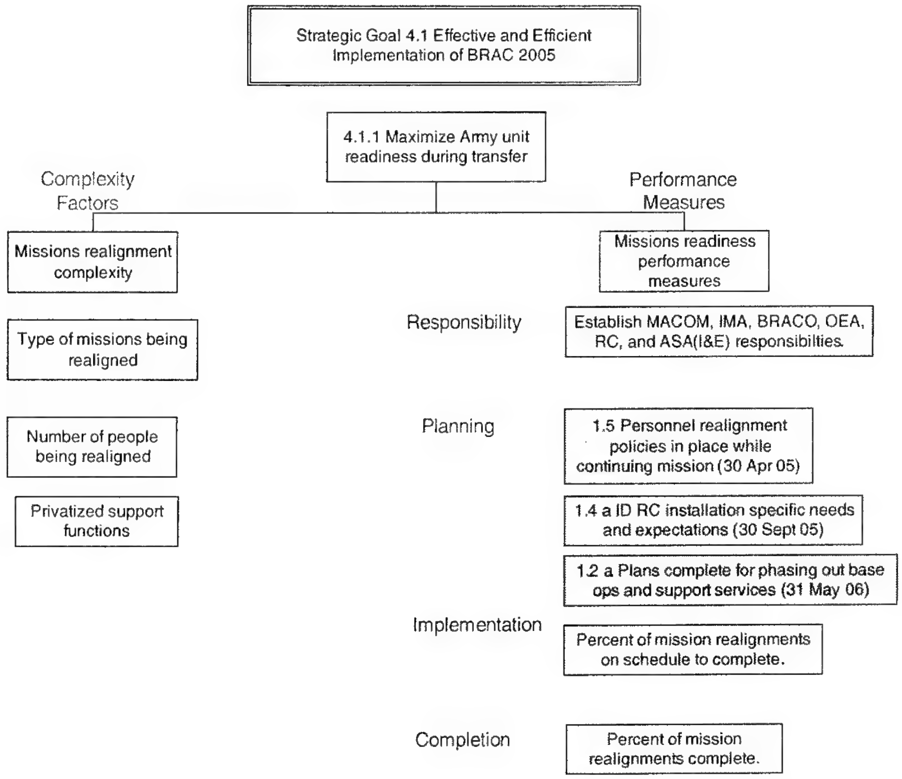
Appendix A: List of Abbreviations

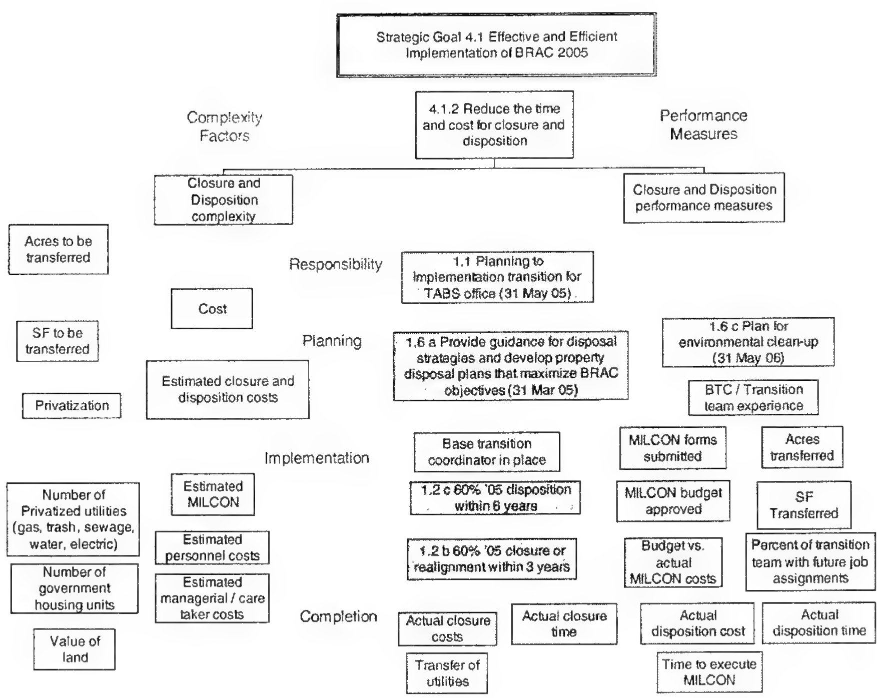
A	
ACSIM	ASSISTANT CHIEF OF STAFF FOR INSTALLATION MANAGEMENT
B	
BRAC	BASE REALIGNMENT AND CLOSURE
BRACO	BASE REALIGNMENT AND CLOSURE OFFICE
D	
DASA (IA)	DEPUTY ASSISTANT SECRETARY OF THE ARMY (INFRASTRUCTURE ANALYSIS)
DTIC	DEFENSE TECHNICAL INFORMATION CENTER
DOD	DEPARTMENT OF DEFENSE
E	
EPA	ENVIRONMENTAL PROTECTION AGENCY
G	
GAO	GOVERNMENT ACCOUNTING OFFICE
I	
IMA	INSTALLATION MANAEMENT AGENCY
L	
LRA	LOCAL RESUSE AUTHORITY
M	
MACOM	MAJOR COMMAND
MEC	MUNITIONS OF EXPLOSIVE CONCERN
MODA	MULTIPLE OBJECTIVE DECSION ANALYSIS
O	
OEA	DOD OFFICE OF ECONOMIC ANALYSIS
ORCEN	OPERATIONS RESEARCH CENTER
S	
SE	SYSTEMS ENGINEERING
SEDP	SYSTEMS ENGINEERING DESIGN PROCESS
T	
TABS	THE ARMY BASING STUDY
U	
UXO	UNEXPLODED ORDANCE
USMA	UNITED STATES MILITARY ACADEMY

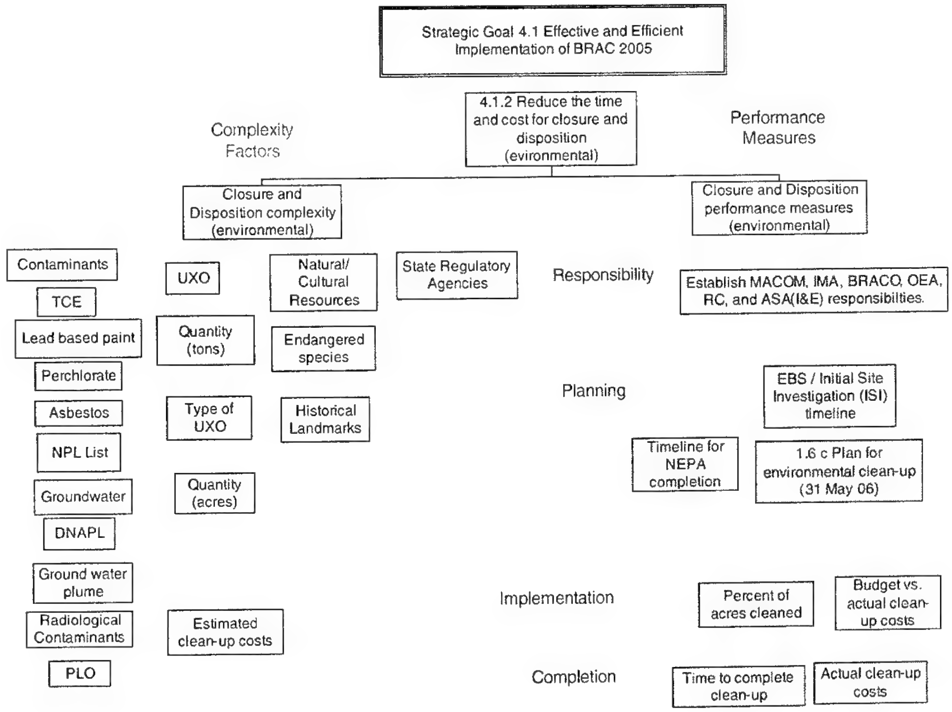
Appendix B: Stakeholder Interviews

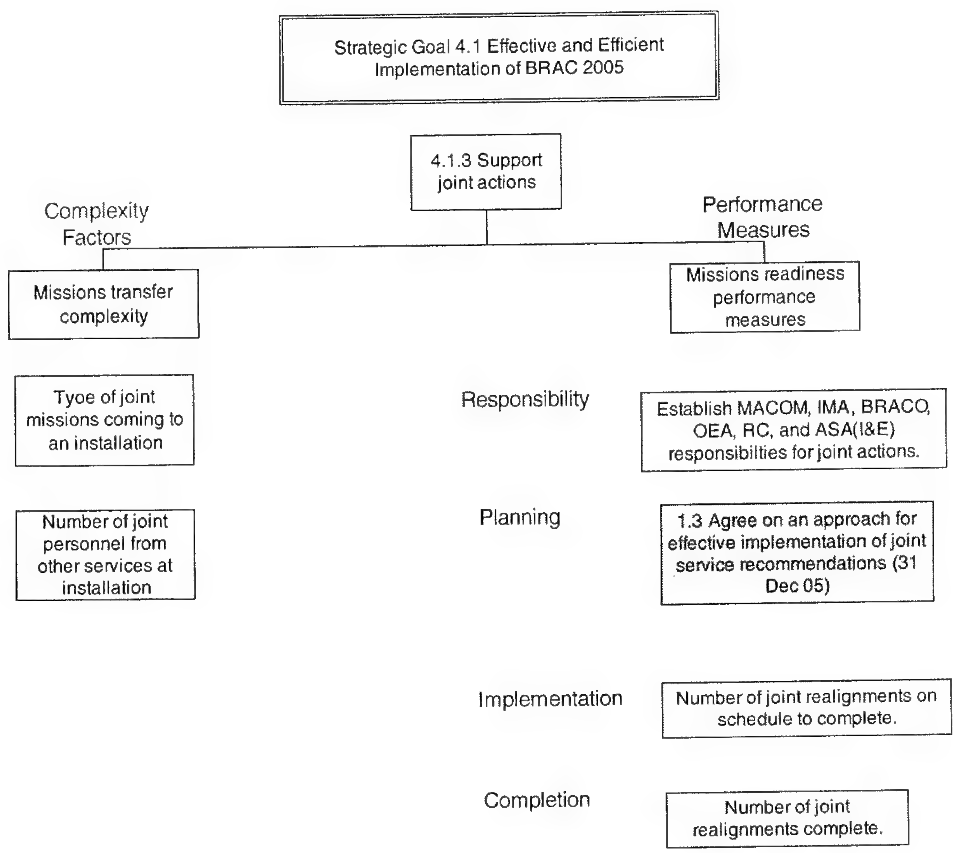
NAME	Organization
Dr. Craig College	DASA IA
COL Douglas Baker, Mr. Larry Beach, and Mr. Bill O'Donnell	ACSIM (BRACO)
Mr. Patrick O'Brien, COL Wendall Taylor, and Mr. Frank Barton	OSD OEA
Mr. Barry Holman	GAO
COL Tarantino, Joe Martore, Rob Dow	TABS Office
Ms. Beth Lachman and Mr. David Oaks	RAND
Dr. Rob Dell	NPS
Mr. Mark Jones	BIC
Ms. Janet Menig, COL Himsl	ACSIM
Mr. John Nerger	ACSIM
Mr. Rick Newsome	ASA-ESOH
Project Managers Panel	ACSIM (BRACO)
Environmental Panel	ACSIM (BRACO)

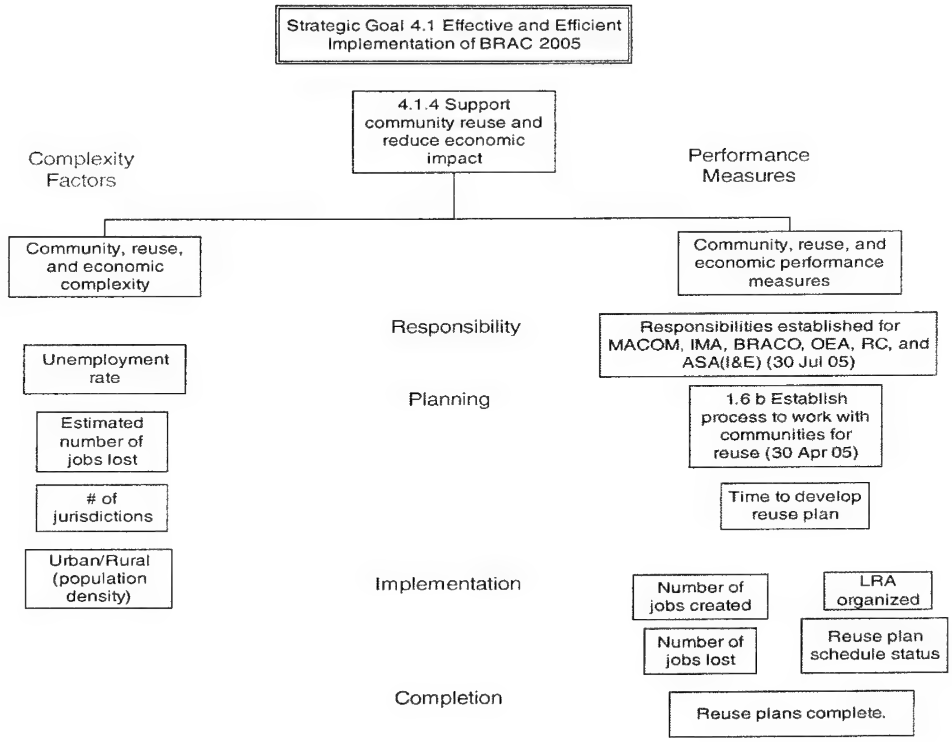
Appendix C: Affinity Diagramming

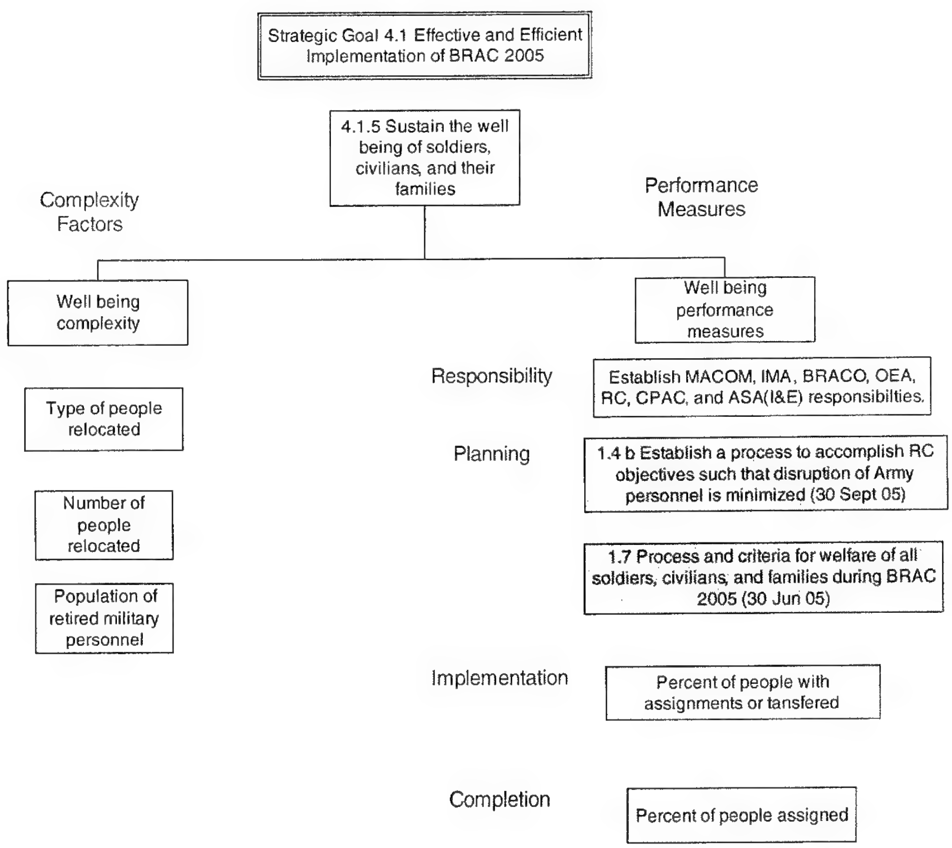





Strategic Goal 4.1 Effective and Efficient Implementation of BRAC 2005
4.1.2 Reduce the time and cost for closure and disposition (evironmental)
Complexity Factors
Performance Measures
Closure and Disposition complexity (environmental)
Closure and Disposition performance measures (environmental)
Contaminants
TCE
Lead based paint
Perchlorate
Asbestos
NPL List
Groundwater
DNAPL
Ground water plume
Radiological Contaminants
PLO
UXO
Quantity (tons)
Type of UXO
Quantity (acres)
Estimated clean-up costs
Natural/ Cultural Resources
Endangered species
Historical Landmarks
State Regulatory Agencies
Responsibility
Establish MACOM, IMA, BRACO, OEA, RC, and ASA(I&E) responsibilties.
Planning
EBS / Initial Site Investigation (ISI) timeline
Timeline for NEPA completion
1.6 c Plan for environmental clean-up (31 May 06)
Implementation
Percent of acres cleaned
Budget vs. actual clean-up costs
Completion
Time to complete clean-up
Actual clean-up costs

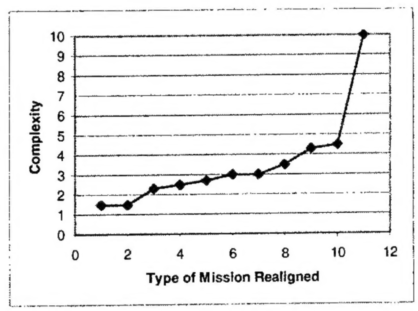

Strategic Goal 4.1 Effective and Efficient Implementation of BRAC 2005
4.1.3 Support joint actions
Complexity Factors
Performance Measures
Missions transfer complexity
Missions readiness performance measures
Tyoe of joint missions coming to an installation
Number of joint personnel from other services at installation
Responsibility
Establish MACOM, IMA, BRACO, OEA, RC, and ASA(I&E) responsibilties for joint actions.
Planning
1.3 Agree on an approach for effective implementation of joint service recommendations (31 Dec 05)
Implementation
Number of joint realignments on schedule to complete.
Completion
Number of joint realignments complete.


Strategic Goal 4.1 Effective and Efficient Implementation of BRAC 2005
4.1.4 Support community reuse and reduce economic impact
Complexity Factors
Performance Measures
Community, reuse, and economic complexity
Community, reuse, and economic performance measures
Responsibility
Responsibilities established for MACOM, IMA, BRACO, OEA, RC, and ASA(I&E) (30 Jul 05)
Unemployment rate
Planning
1.6 b Establish process to work with communities for reuse (30 Apr 05)
Estimated number of jobs lost
# of jurisdictions
Time to develop reuse plan
Urban/Rural (population density)
Implementation
Number of jobs created
LRA organized
Number of jobs lost
Reuse plan schedule status
Completion
Reuse plans complete.

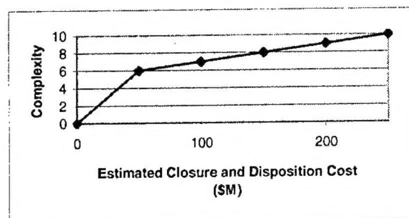

Strategic Goal 4.1 Effective and Efficient Implementation of BRAC 2005
4.1.5 Sustain the well being of soldiers, civilians, and their families
Complexity Factors
Performance Measures
Well being complexity
Well being performance measures
Responsibility
Establish MACOM, IMA, BRACO, OEA, RC, CPAC, and ASA(I&E) responsibilties.
Type of people relocated
Planning
1.4 b Establish a process to accomplish RC objectives such that disruption of Army personnel is minimized (30 Sept 05)
Number of people relocated
1.7 Process and criteria for welfare of all soldiers, civilians, and families during BRAC 2005 (30 Jun 05)
Population of retired military personnel
Implementation
Percent of people with assignments or tansfered
Completion
Percent of people assigned

Appendix D: Complexity Functions for the Aggregated Installation Complexity Model

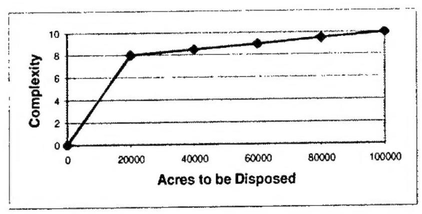
Maximize Army Unit Readiness		
Evaluation Measure	Type of Mission Realigned	
Mission	x	Complexity
Minor Training AC	1	1.5
Minor Training RC	2	1.5
Housing	3	2.3
Depot	4	2.5
RDT&E / Labs	5	2.7
Major Training AC	6	3
Major Training RC	7	3
Medical	8	3.5
Administration	9	4.3
Industrial	10	4.5
Transport	11	10
Evaluation Measure description.		



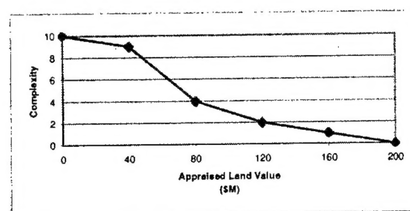
Reduce the Time and Cost for Closure and		
Evaluation Measure	Estimated Closure and Disposition Cost	
Millions of $	x	Complexity
	0	0
	50	6
	100	7
	150	8
	200	9
	250	10
Evaluation Measure description.		



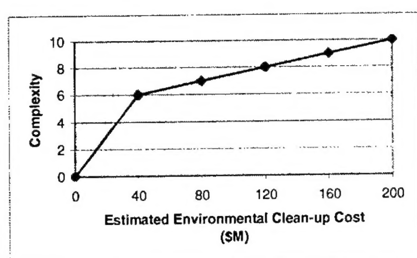
Reduce the Time and Cost for Closure and		
Evaluation Measure	Acres to be Disposed	
Acres	x	Complexity
	0	0
	20000	8
	40000	8.5
	60000	9
	80000	9.5
	100000	10
Evaluation Measure description.		



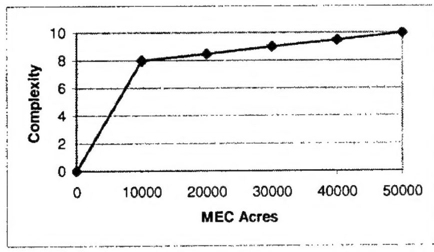
Reduce the Time and Cost for Closure and		
Evaluation Measure	Appraised Land Value	
Millions of $	x	Complexity
	200	0
	160	1
	120	2
	80	4
	40	9
	0	10
Evaluation Measure description.		



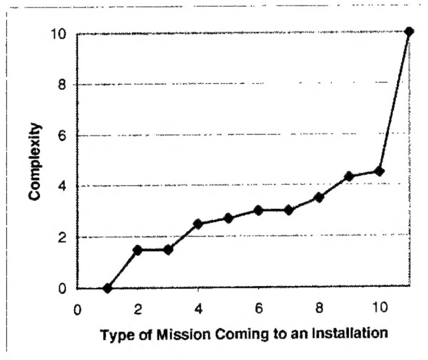
Reduce the Time and Cost for Closure and		
Evaluation Measure	Estimated Environmental Clean-up Cost	
Millions of $	x	Complexity
	0	0
	40	6
	80	7
	120	8
	160	9
	200	10
Evaluation Measure description.		
Evaluation measure sources:		
Type of evaluation measure		



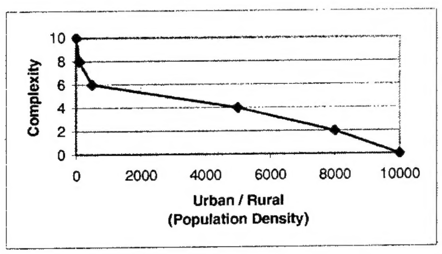
Reduce the Time and Cost for Closure and		
Evaluation Measure	MEC Acres	
Acres	x	Complexity
	0	0
	10000	8
	20000	8.5
	30000	9
	40000	9.5
	50000	10
Evaluation Measure description.		
Evaluation measure sources:		
Type of evaluation measure		



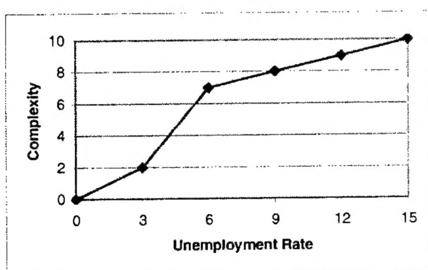
Support Joint Actions		
Evaluation Measure	Type of Joint Mission Coming to an Installation	
Mission	x	Complexity
None	1	0
Minor Training AC	2	1.5
Minor Training RC	3	1.5
Depot	4	2.5
RDT&E / Labs	5	2.7
Major Training AC	6	3
Major Training RC	7	3
Medical	8	3.5
Administration	9	4.3
Industrial	10	4.5
Transport	11	10
Evaluation Measure description.		
Evaluation measure sources:		
Type of evaluation measure		



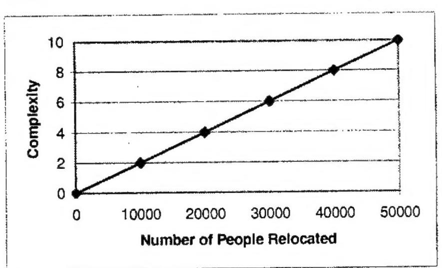
Support Community Reuse and Reduce Economic		
Evaluation Measure	Urban / Rural	
Population Density	x	Complexity
	10000	0
	8000	2
	5000	4
	500	6
	100	8
	0	10
Evaluation Measure description.		
Evaluation measure sources:		
Type of evaluation measure		



Support Community Reuse and Reduce Economic		
Evaluation Measure	Unemployment Rate	
% Rate	x	Complexity
	0	0
	3	2
	6	7
	9	8
	12	9
	15	10
Evaluation Measure description.		
Evaluation measure sources:		
Type of evaluation measure		



Support the Well-Being of Soldiers, Civilians, and		
Evaluation Measure	Number of People Relocated	
Number of People	x	Complexity
	0	0
	10000	2
	20000	4
	30000	6
	40000	8
	50000	10
Evaluation Measure description.		
Evaluation measure sources:		
Type of evaluation measure		



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13. SUPPLEMENTARY NOTES

14. ABSTRACT This project was initiated by the DASA-IA (Deputy Assistant Secretary of the Army for Installation Analysis) w coordination with the ACSIM's (Assistant Chief of Staff for Installation Management) BRAC (Base Realignment and Closure) Di requested two related but distinct project tasks. The first task was to produce a BRAC Installation Complexity Matrix which would b by BRAC 2005 implementation planners to assess the difficulty of realigning and disposing of each installation. The second task develop BRAC 2005 implementation performance measures. To perform these tasks, we read reports on past BRACs, intervieweu stakeholders, and collected data on past BRAC rounds. Based on our research, we identified possible hypotheses about factors that inf installation complexity. Then we analyzed the data using descriptive statistics and regression analysis to determine the validity hypotheses. The validated hypotheses were used to develop the BRAC 2005 Army Complexity Model. The model was implemente decision support tool using Logical Decisions software and Excel. Based on our research and historical data analysis, we also dev performance measures to assess the BRAC 2005 implementation.

15. SUBJECT TERMS
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